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## HumRRO Research on Project 100,000

by

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### **Prefatory Note**

This paper was presented at the American Psychological Association convention as part of a symposium entitled, "Project 100,000 and Research on Lower Ability Personnel." The presentation incorporated findings and plans from Work Units SPECTRUM, APSTRAT, REALISTIC, and UTILITY, of the Human Resources Research Organization. The topics included research data and plans on training and performance of men varying in aptitude and ability level.

Dr. McFann is Director of Research at Division No. 3, Presidio of Monterey, California, where the research took place.

## HumRRO RESEARCH ON PROJECT 100,000

Howard H. McFann

At HumRRO there are two objectives in our work with the Army's Project 100,000: (a) an applied objective—the impact the lower aptitude personnel have on existing training and operations, and (b) a research objective—understanding more fully the relationship between measured aptitude and performance.

The research is concerned with the complete spectrum of aptitudes, with an emphasis on the lower aptitude men. Key questions that require answering are the extent to which AFQT scores are related to acquisition and performance, and if they are related, which techniques and procedures will allow for efficient and effective training and utilization of men at all aptitude levels.

Although training and on-the-job performance are obviously interrelated, for ease of presentation I have arbitrarily separated them. In the first section of this paper, the initial individual training of the soldier which occurs in Army Training Centers will be discussed. Training Centers conduct a common basic course for all enlisted men, Basic Combat Training (BCT), plus Advanced Individual Training (AIT), for the military jobs that involve large numbers of men. In addition to training men for specific combat jobs such as in Infantry and Armor, training is given for such varied jobs as clerks, typists, automotive mechanics, vehicle operators, cooks and bakers, telephone linemen, and medical corpsmen—jobs that have definite civilian counterparts. The objective of this training is to provide the man with prerequisite skills and knowledges so he can perform effectively at the job entry level. It is to combat and combat support courses that most PROJECT 100,000 men are being assigned.

In addition to the wide variety of content or occupations, the Army trains a highly diverse population, varying over time as the result of both the numbers of men needed and changes in policies of enlistment and induction standards. The decision to lower Armed Forces Qualification Test (AFQT) standards has resulted in a large training load characterized by a wide spread of individual ability and background ranging from elementary school to college graduate level.

Although formal selection procedures based on such factors as aptitudes, abilities, prior experience, and schooling, allow for narrowing of the input to a course, wide differences in entry level skills and ability still exist. For the most part, instruction in Army Training Centers can be characterized as a single track system with minimum standards for graduation prescribed. All the men enter together and receive the same program of instruction, but not all make it through

the course the first time. Some are "washed-back" or recycled, and generally receive the same instruction a second time. The general method of instruction is the lecture-demonstration-practice paradigm with the content sequenced by subject matter. Sufficient data exist to raise a question as to the appropriateness of these practices for training lower aptitude men. Courses have been and are being revised to emphasize less lecture and more practice as well as to function-alize the content.

A key problem with the instructional approach, which has been accentuated with the increase of low aptitude men, is where to gear the instruction. If it is geared toward the low ability level, then the more capable are held back with resulting boredom, poor attitude, and poor efficiency in instruction. If instruction is focused toward the higher ability, then there is a situation of many who are failures (unduly high attrition rates) or many who are moved forward without mastering the material (1).

From our examination of both Basic Combat Training (2) and Combat Support Training (1), a general finding has been a significant and meaningful relationship between aptitude as measured by AFQT and success in training. These differences exist in BCT and are more pronounced in Combat Support Training. These group differences exist for both cognitive and motor skill tasks with, as expected, the difference being greater for cognitive tasks. Most men eventually make it through a course, but whether they successfully meet minimal standards the first time through is highly related to AFQT scores.

Further information on the relationship between aptitude level and training performance was obtained in laboratory research (3, 4) which had as its purpose the clarification of the relationship between aptitude level and the acquisition of military skills and knowledges in a variety of tasks that varied in complexity.

Groups of High (AFQT 90-99), Middle (AFQT 45-55), and Low (AFQT 10-21) aptitude subjects were trained on the tasks listed in Figure 1 (3). These tasks were selected on the basis of two criteria: First, that the tasks should have elements common to the knowledge and skill requirements of a large number of jobs; Second, that they should be representative of several levels of complexity.

Instructional methods were selected to maximize the low aptitude recruit's opportunity to learn. Where practical, instruction was automated to insure standardization and clarity, using audio-visual presentations including slides and video tape. Verbal instruction was given in simple language with ample pictorial examples. All training was conducted individually with an instructor present to give prompts, answer questions, and provide immediate knowledge of results after each response. Instruction was repeated or reviewed, as appropriate, and practice was provided on each trial.

The results of this laboratory study were consistent in demonstrating large differences among the three different AFQT levels on all tasks. In general, the low AFQT subjects were slower to respond, required more training time to attain a specified criterion, needed

## Ordering of Tasks Along a Dimension of Complexity

| Description of Learning Requirements   | Task  |
|--|---|
| <b>Complex</b><br>Requires learning of <i>concepts and principles</i> and their application in a problem situation | Position Plotting   |
| Requires <i>multiple discrimination</i> of words and symbols (serials or paired-associate learning)                | Map Symbols<br>Phonetic Alphabet  |
| Requires learning of <i>fixed procedures</i> ; either verbal or motor (chaining of verbal or motor responses)      | Equipment Preparation<br>(verbal procedure)<br>Rifle Assembly<br>Rifle Disassembly<br>(motor procedure) |
| <b>Simple</b><br>Requires association of <i>stimulus and response</i>  | Choice Monitoring<br>Simple Monitoring  |

Figure 1

more guidance and repetition of instruction, and were decidedly more variable as a group than the middle and high aptitude subjects. On almost every task there were a few men with low AFQT scores whose performance matched that of the middle and high groups; similarly, on almost every task there were some low AFQT subjects who failed to reach criterion. The remaining men were spaced over a wide range of performance.

Depending on the particular task, low AFQT subjects required from two to four times as much training time, from two to six times as much prompting, and from two to five times as many trials to reach criterion as did the high AFQT group.

The learning performance of the middle AFQT group was typically intermediate between the high and low groups, but more like the high group. In some tasks AFQT groups differed in rate of learning only; in others, groups differed both in rate of learning and in final level of performance. In simple response tasks AFQT groups differed in both speed and accuracy of response.

This research along with other related studies has established the relationship of AFQT score to (a) a variety of psychometric tests employed for classification and assignment, (b) scholastic achievement as indicated by scores on reading and arithmetic tests, and (c) success in training. A general conclusion is that efficient training of men at all levels of aptitude will depend upon the recognition of individual differences, and the design of instructional programs that are

compatible with individual differences in learning rate and final performance capability.

We have a series of research efforts (5) in progress that are aimed at providing information to further the development of operational training strategies for the military training population. The term "training strategy" means an arrangement of learning conditions that provide maximum opportunity for an individual to acquire criterion performance in a given task.

Under HumRRO Work Unit SPECTRUM, Development of Efficient Training Across All Aptitude Levels, we are studying the relationships among the following training strategy variables:

| <u>Individual Difference Variables</u>    | <u>Task Variables</u>   | <u>Training Method Variables</u>  |
|---|---|---|
| Aptitude Level (AFQT)                     | Complexity Level  | Training Procedures   |
| Reading, Listening, and Arithmetic Skills | Abstract Principles<br>Verbal Multiple Discrimination<br>Simple Motor | Knowledge of Results<br>Inductive-Deductive Balance<br>Pace of Presentation<br>Size of Step |
| Demographic Data                          | Difficulty Level  | Trainee Participation<br>Self-Instruction<br>Guidance of Responses<br>Amount of Repetition  |
| Army Classification Battery Scores        |   |   |
| Nonverbal Mental Abilities                |   | Training Content<br>Meaningfulness of Task<br>Language Involvement                          |
|   |   | Training Resources<br>Human<br>Material<br>Physical Facility                                |

Individual Difference Variables: Aptitude for training, as measured by AFQT score, has been given primary emphasis because of the major concern with the problem of training lower aptitude men. As indicated above, reading, listening, arithmetic, and certain nonverbal mental abilities are being measured. We are also examining demographic and other data from the Army Classification Battery.

Task Variables: Complexity, which varies as the requirement for symbolic mediation varies, is the primary task variable. We have developed a variety of tasks that are representative of a wide range of military skills and have put them together into an interrelated, progressively developing training sequence extending over several days, in contrast to an assemblage of short, unrelated learning tasks as was done in the research previously discussed.

Training Method Variables: The training method variables were selected on the basis of their judged importance, relevance, and amenability to manipulation and measurement. Three subclasses of training method variables are being considered—procedures, content, and resources.

The "Training Procedures" variables are those dealing with dynamic processes or interactions between student and instructor, live or not, by which training content is imparted to the student. The "Inductive-Deductive Balance" pertains to the general method of presenting task content. Are specific elements presented to be integrated into a more general procedure or are general procedures followed by specific elements? Most of the other training procedures are self-explanatory except possibly for "Guidance of Responses" which refers to the amount of prompting and individual guidance available to the learner during the training sequence. Also, the "Amount of Repetition" covers both the amount of explanation and the amount of practice.

"Training Content" variables are those dealing with the structure and organization of the various tasks or skills and knowledges. "Meaningfulness of Task" refers to the functional relevance of the individual's background experience to the training content and to the functional interconnections among the major elements of the content. "Language Involvement" includes the relative amount of verbal content present in instruction and the difficulty level of language used to present the content.

"Training Resources" variables refer to the availability and employment of (a) instructors, (b) materials such as work books or training aids, and (c) physical facilities such as classrooms and outdoor training areas.

The research approach involves selecting various values of the training method variables and studying their interaction with the individual difference variables where the task variables are constant. Several modes of presentation or media are being tried out with these selected training strategy variables. For example, texts, audio-visual presentations, and live instructors are modes of instruction that can be compared for various combinations of the training strategy variables. The goal is to determine the potency of combinations of training method variables with various complexity levels of content, for a variety of aptitude levels, when different methods or modes of instruction are employed.

Clearly, to test all combinations of training variables and media is prohibitive in time and expense, and unnecessary since previous research information gives some guidance and since some of the training method variables are mutually exclusive. Nevertheless, the job is a formidable one that requires a series of iterative studies. Once some of these variables have been mapped out, we will introduce a third factor involving different incentive or reinforcement programs where we will manipulate kind, quantity, and frequency of reinforcement. We are at present collecting data. Our current focus is on the low AFQT subjects, and we have selected initial levels of the training method variables.

HumRRO Work Unit APSTRAT, a companion project to the one described, has as its objective the development of instructional systems appropriate for a wide range of trainee aptitudes with the systems to be tested in operational settings. In this manner not only can we obtain information on the effectiveness of training strategies when they are employed "in the field" but also we can obtain information on management or organizational considerations. For this research we are concerned with an eight-week course, with classes starting each week, using regular Army instructional staff.

An Army Field Wireman Course has been selected as the research vehicle because it incorporates a wide variety of tasks and because the trainee input typically has a wide range of aptitude levels. Members of the research staff have system-engineered the course to determine terminal objectives and standards. The approach is to individualize instruction without grouping by ability. Various training media or modes are being developed so the trainee will have a choice of various options. A special feature of the course will be the assumption of considerable self-responsibility by the student.

The program of instruction is being developed to allow for assessment of entry level skills and knowledges with mastery of material required before moving from one sequence of instruction to another. The content has been reorganized away from the usual subject matter blocks of instruction to an integrated task or problem-solving approach. Attention is being given to instructional or management variables to include instructor role, incentive system, and use of facilities. Formal testing of the initial version of the program was under way at the time this paper was prepared.

Another HumRRO Work Unit, REALISTIC, is concerned with literacy. The effort is aimed at determining reading, listening, and arithmetic skill levels required for major occupational specialties and developing guidelines for reducing discrepancies between skill levels of personnel and levels required by the job. This work resulted from the recognition that many of the Project 100,000 men are deficient in basic literacy and arithmetic skills. Some 30% read at or below fourth grade level of ability and approximately 80% read at or below the seventh grade level (6). The implication of deficiencies in reading, listening, and arithmetic clearly depends upon the relevance of such skills for the jobs to which men are assigned. By determining the literacy level needed by the man on the job, training and material such as handbooks and manuals can be examined to determine if the requirements are needlessly high or how they might be modified to be more in line with the existing skills of the personnel assigned to the jobs.

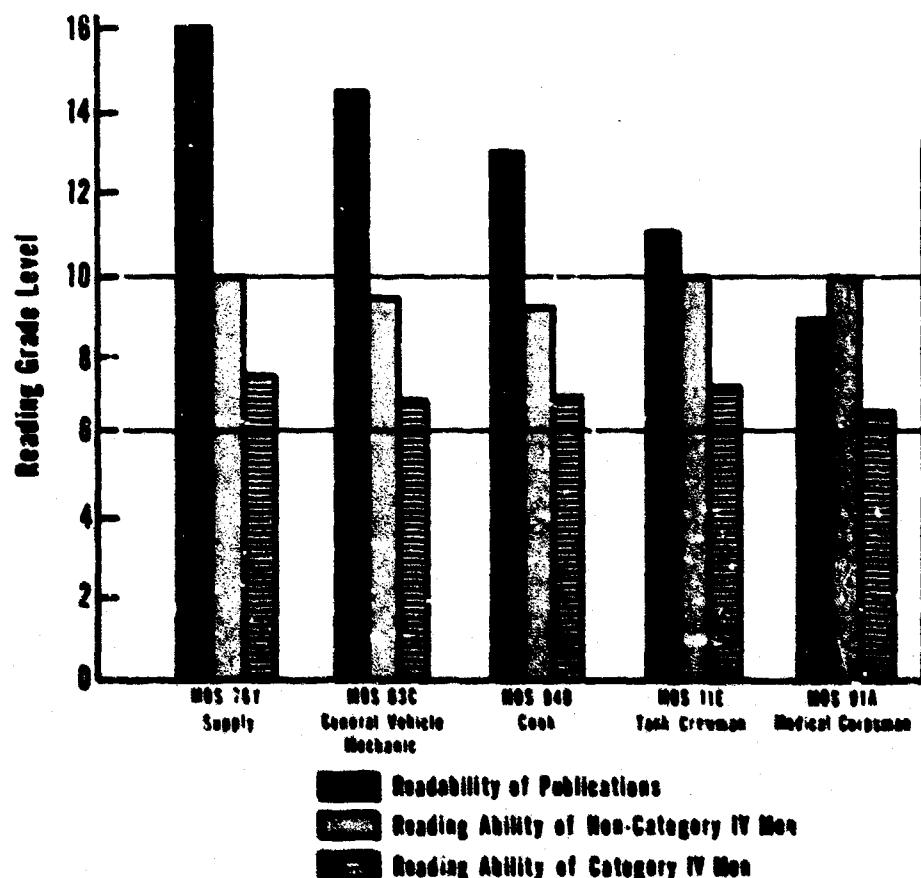
Another facet of the problem is to determine ways whereby training or jobs might be modified or reconstructed to match the skill levels of different individuals. For example, one method of adapting training or job requirements to accommodate men having deficient reading skills is to remove the reading requirement where feasible. For this reason, research is being done to assess the feasibility of substituting learning-by-listening for learning-by-reading for trainees whose

reading skills are poor or who prefer to listen. One study (7) indicates that some 25% of the trainees, regardless of aptitudes, prefer listening to reading. The results indicate that with average and low aptitude groups, listening is as effective as reading for promoting recall of factual material and also, that moderately time-compressed speech is a feasible and efficient means for transmitting much information. Where possible, it appears that it would be advantageous to provide both reading and listening material.

To obtain information on literacy, research personnel are examining written job materials to determine their literacy level, are inquiring as to what manner and to what extent such materials are employed and are required, as well as determining the ability of job incumbents.

Evidence has been obtained to indicate that the difficulty level of many written materials, such as Field Manuals and Technical Manuals used in training and on the job, does not match the ability of the men who are expected to use them (8). Figure 2 presents some data summarizing such findings. Readability of publications for five different

**Readability of Publications in Use in Various MOSs**



**Figure 2**

military jobs was determined, as was the reading ability of job incumbents. Readability or difficulty level of the manuals was determined by both the Flesch (8) and Dale-Chall formula (8). Reading ability was assessed by the Survey of Reading Achievement, Junior High Level, California Test Bureau. Figure 2 shows for each of five military jobs, comparison of the readability levels of the publication with the reading abilities of average and low mental aptitude men who work in the job. As shown in the bar diagram, there is a considerable discrepancy between the man's ability and the material with the greatest difference being for the Supply specialty and the least for the Medical specialty.

Other data suggest that it is the "poor" reader who is hurt more than the "good" reader when the difficulty of materials is increased (7). Further, some findings indicate that the material can be made more comprehensible without reducing the technical information (9). Presently under way is an attempt to develop a schema that will allow for more extensive ways of describing and classifying various kinds of printed material, to include the kind of material, the structure of the material, intended use of the material, as well as its readability. It is too early to determine how comprehensive or successful this schema will be.

The relationship of reading, listening, and arithmetic to job performance for selected military jobs is being done in conjunction with another HumRRO Work Unit—UTILITY. This effort is concerned with on-the-job performance and has the following objectives: First, to find out how men in Mental Category IV and in other mental categories compare in performance of selected jobs, and second, to determine which factors or combinations of factors relate to satisfactory performance; that is, to identify attributes such as background or personal characteristics, as well as the role of more general parameters such as degree of job experience and type of training as they relate, either individually or in particular combinations, to effective performance in different jobs.

It is assumed that information about a man, his performance capabilities and the way these relate to his prior experiences will be useful in screening, preparing, and assigning men. Thus, selection, assignment, additional training, or restructuring of jobs may be choices for men at the lower end of the ability spectrum whereas for men at the upper end, options such as the shortening or elimination of formal training might be suggested.

Also, in those jobs that make few verbal and intellectual demands, success may depend far more on motivational, attitudinal, and other noncognitive characteristics of the workers than upon their abstract verbal abilities.

The particular jobs were selected on the basis that there was a fair proportion of lower mental category men in the job; that they would give a reasonably good representation of different kinds of jobs, and with the exception of the Armor Crewman would represent jobs that have counterparts in all branches of military service and in civilian

life. The Armor Crewman is an operator's job where many of the tasks, dictated by hardware requirements, are highly procedural. The General Vehicle Repairman's maintenance job involves diagnostic and interpretive skills. The Supplyman's job is largely a clerical one, involving the coordination of information. The Cook, a job where men of lower aptitude have frequently been placed, requires to a great extent following specified instructions and meeting rather precise standards in largely procedural tasks, while a Medical Corpsman's job is to provide personal services in attending to others' needs. A basic outline of the UTILITY Work Unit is:

| Independent Variables | Criterion Measures   | Descriptor Variables    |
|-----------------------|----------------------|-------------------------|
| Military Job          | Performance Tests    | Demographic Information |
| Armor Crewman         | Knowledge Tests      | Age, Education, and     |
| Mechanic              |                      | so forth                |
| Supply                | Supervisors' Ratings | Intelligence, Literacy, |
| Cook                  |                      | Memory Tests, and       |
| Medic                 |                      | so forth                |
| Mental Category Group |                      |                         |
| Time on Job           |                      |                         |

For each job, Mental Category IV men were matched with non-Category IV men by time on the job to insure as far as possible equal amounts of job exposure. The sample consisted of 180 pairs or 360 men for each job, for a total of 1800 men.

The criterion measures employed were especially developed job sample tests, knowledge tests, and supervisor ratings, as well as such indicators as career progression and misbehavior history. The main emphasis, however, is on the job sample or performance test, which, incidentally, represents extremely difficult information to obtain. For each job, the development involved analysis of the job as to scope of activities, and the tests incorporate not only sampling or breadth of activities performed but also the criticality of the task and frequency of its occurrence. Test personnel were especially trained to insure standardization of administration and scoring. Subjects were tested individually with the tests taking from three to five hours depending upon the nature of the job. With this information we will be able to determine the relationship among the various criterion measures as well as their relationship with various descriptor or predictor measures.

The descriptor variables include demographic information that appears in the man's permanent record such as AFQT score, aptitude test score, age, race, and military and civilian educational history. Further, information collected from each man includes biographical questionnaires and checklists, a nonverbal measure of intelligence, tests of carefulness and the ability to comprehend and follow oral directions, tests of memory and digit span, a group form of the Porteus Maze test

developed by the Navy Personnel Research Field Activity, and tests of reading, arithmetic, and listening comprehension. Also, job duty information was collected from the man and his supervisor. Many of these tests have been used by other researchers or were commercially available so the main task was one of selecting tests rather than developing new ones.

Obviously, there is a great deal of information available on each man. We feel that with the analysis of these data we will be able to provide information of value to the Military Services. Our goal is to achieve a much better understanding about men of varying aptitudes and background experiences and factors related to success in diverse kinds of jobs. The problems of aptitude level, performance, and training are enormous, but the payoff of research in this field, both in terms of individual training and amelioration of social problems seems, to us at HumRRO, to be well worth the effort.

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| 13. ABSTRACT<br>This paper presents the general research plans and some findings of HumRRO research associated with Project 100,000. The research objectives are to obtain information on what, if any, impact men taken into the Army under this program will have on training and operations, and to understand the relationship between measured aptitude and performance both in training and on the job. Summary data show the general relations' p between Armc Forces Qualification Test scores and performance to include laboratory tasks and operational training. One of the conclusions is that efficient and effective training must take into account individual differences. Plans are presented which have the goal of providing necessary information on factors involved and techniques to account for them. |   |  |

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|------------------------|--------|----|--------|----|--------|----|
|                        | ROLE   | WT | ROLE   | WT | ROLE   | WT |
| Aptitude Level         |        |    |        |    |        |    |
| Individual Differences |        |    |        |    |        |    |
| Individual Performance |        |    |        |    |        |    |
| PROJECT 100,000        |        |    |        |    |        |    |
| Training               |        |    |        |    |        |    |

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